review

ON THE ECONOMICS OF CLIMATE CHANGE

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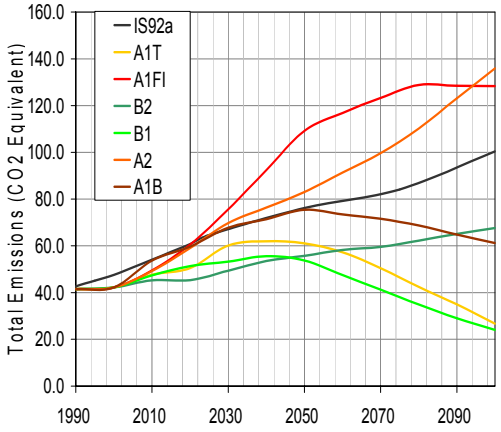
What is the economics of climate change and how does it depend on the science?

Climate change is an externality with a difference:

- Global
- Uncertain
- Long-term
- Potentially large and irreversible

Working with Uncertainty



Population, technology, production, consumption

Emissions

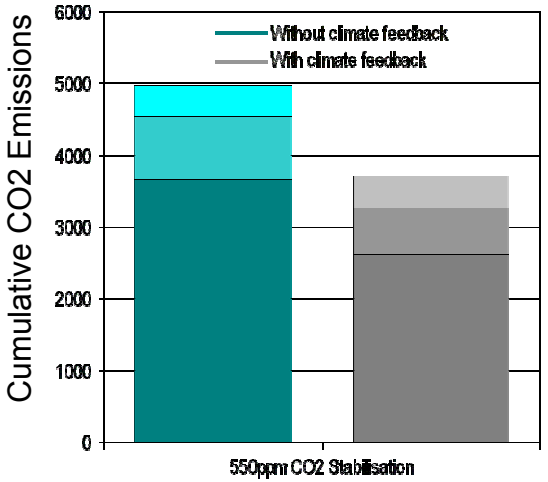
Atmospheric concentrations

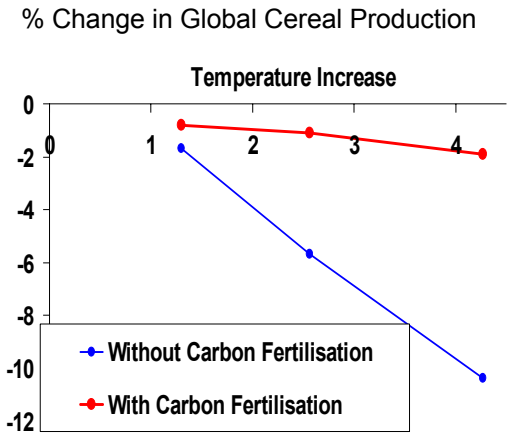
Radiative forcing

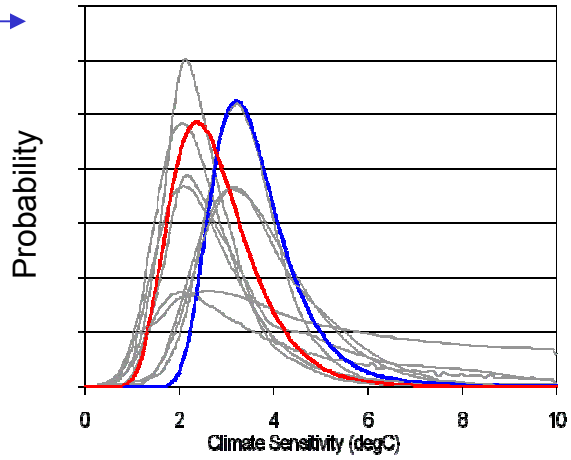
Temperature rise and global climate change

Direct impacts (e.g. crops, forests, ecosystems)

Socio-economic impacts

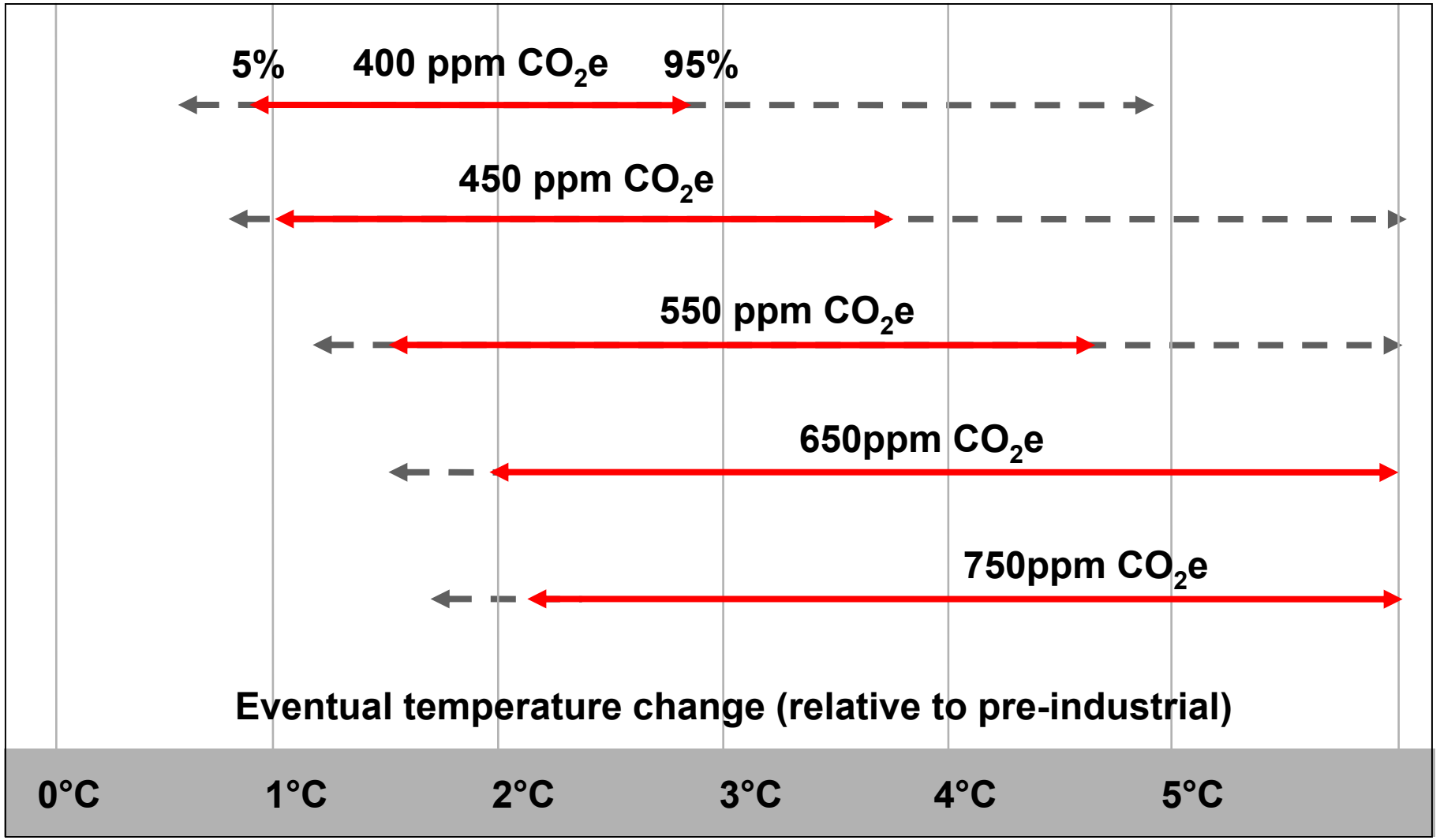






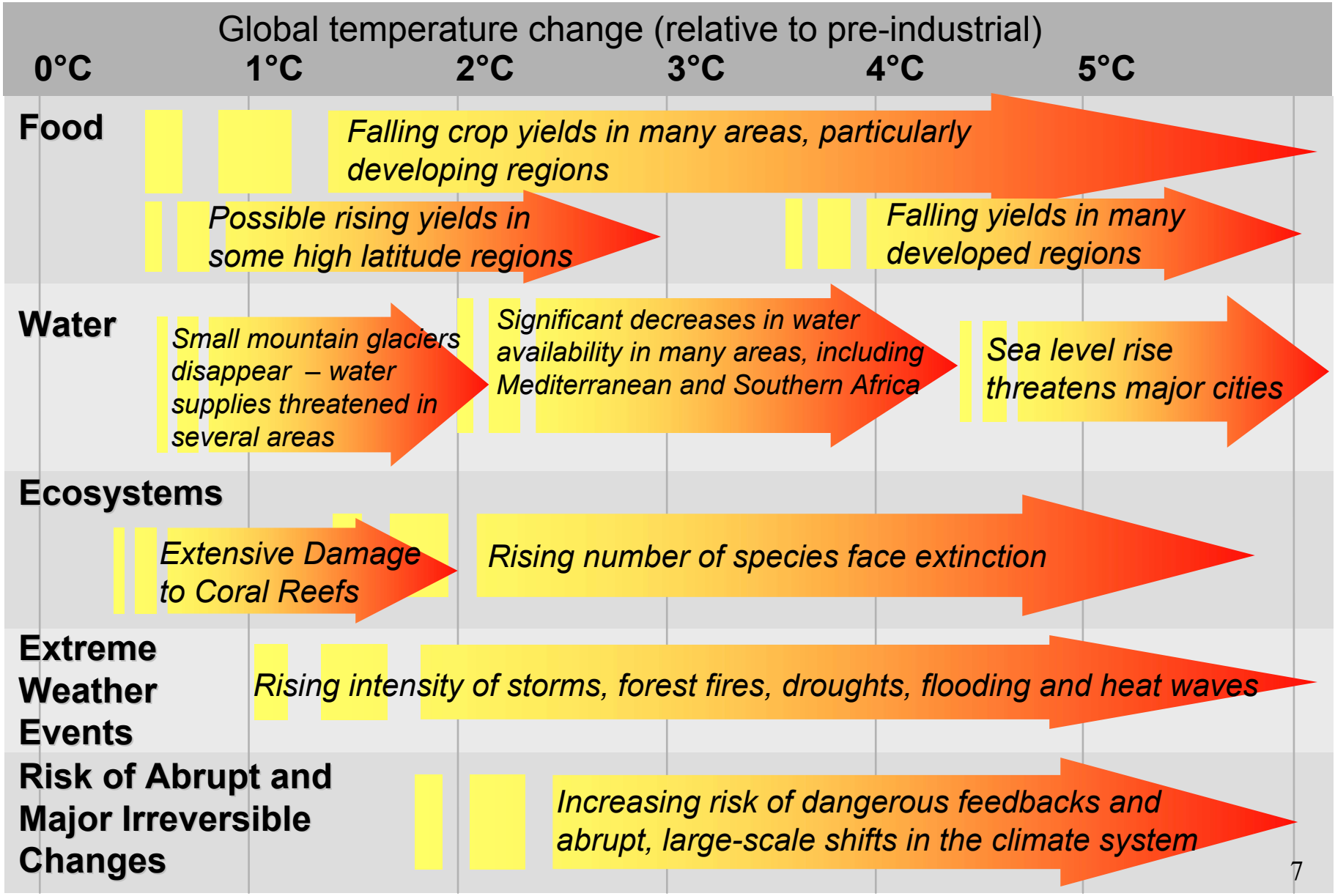
SCIENCE

Stabilisation and Commitment to Warming



DAMAGES

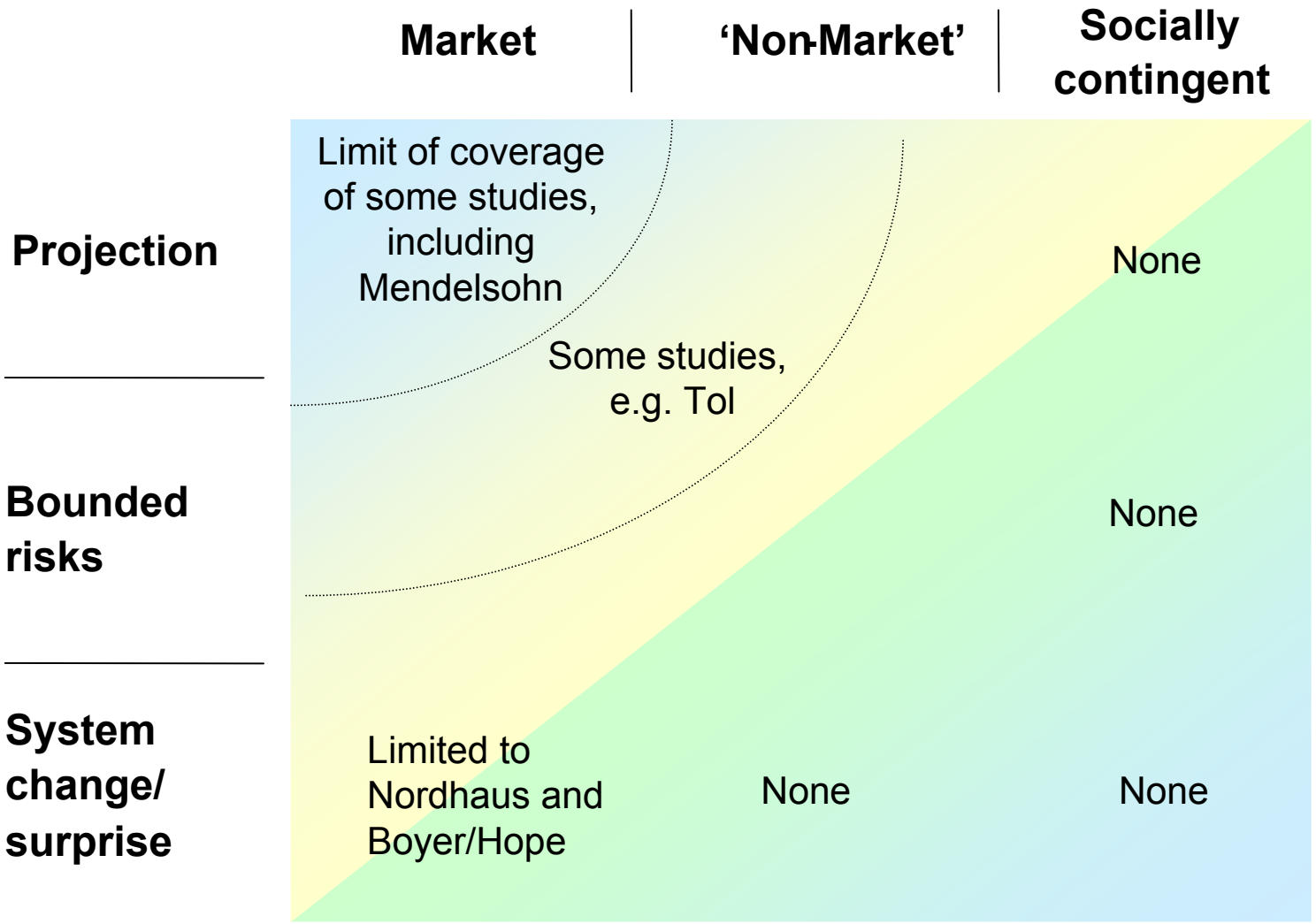
Projected Impacts of Climate Change



Understanding Disaggregated Impacts

- **Developing countries** (especially vulnerable)
  - Rising water stress
  - Falling agricultural yields/incomes
  - Malnutrition and disease
  - Migration and conflict

- **Developed countries** (not immune)
  - Water stress in S. Europe and California
  - Costs of extreme weather events
  - Sea level rise
  - Higher insurance costs

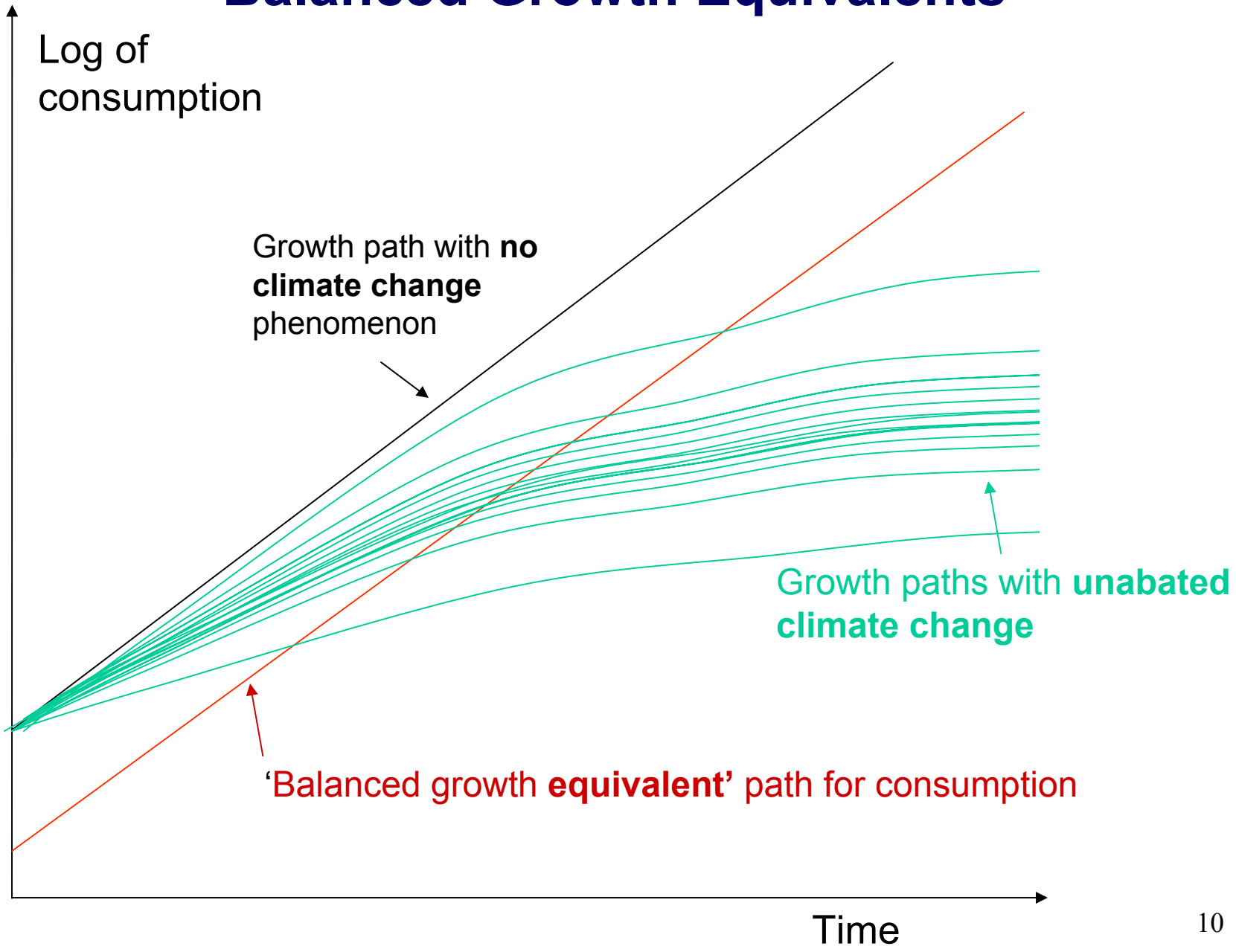


Models only have partial coverage of impacts

Values in the literature are a sub-total of impacts

Source: Watkiss, Downing *et al*. (2005)

‘Balanced Growth Equivalents’



Aggregate Impacts Matrix

- Essential to take account of **risk and uncertainty**
- Models do **not** provide **precise** forecasts
- Assumptions on **discounting, risk aversion and equity** affect the results

	Market impacts	Broad impacts
Baseline climate	5% Range 0-12%	11% Range 2-27%
High climate	7% Range 1-17%	14% Range 3-32%

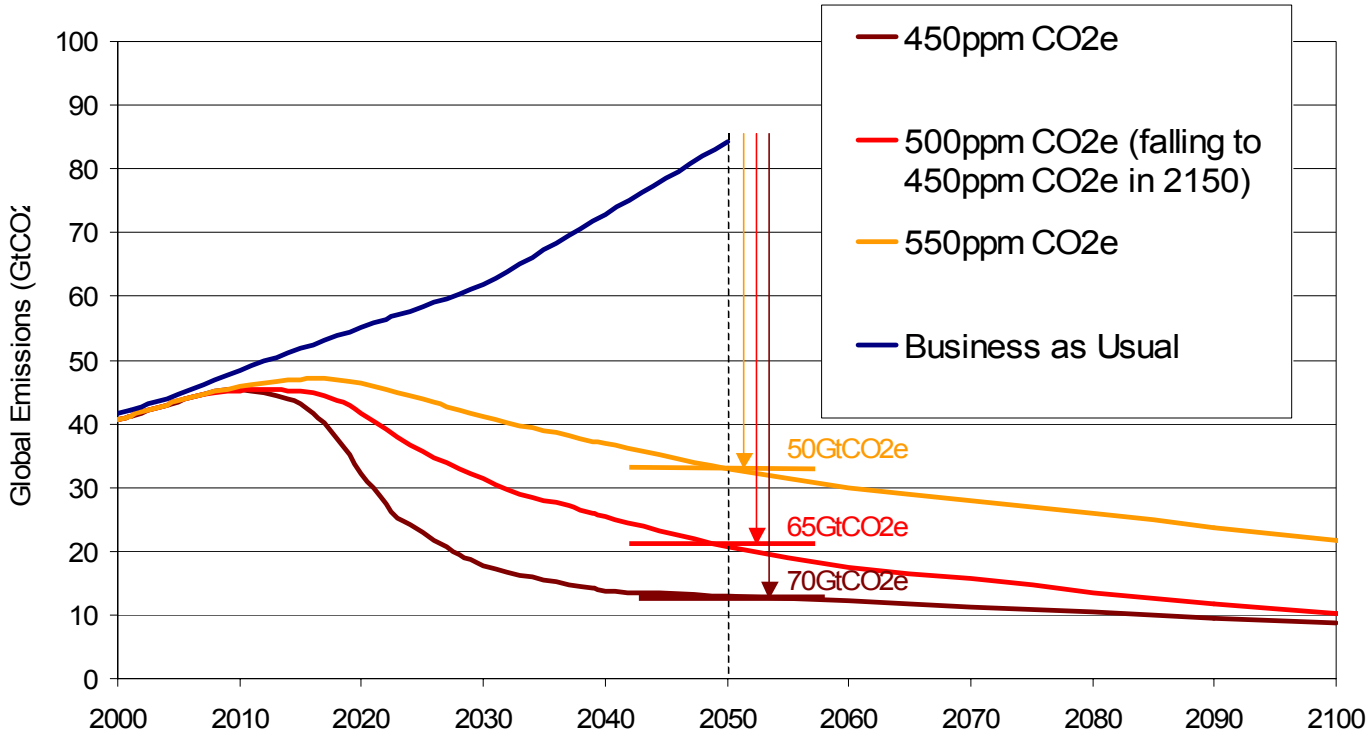
Discounting

Pure time discount rate (%) δ	Probability of human race surviving 100 years
0.1	0.905
0.5	0.607
1.0	0.368
1.5	0.223

Discount Rate: η x GDP growth rate + δ

STABILISATION

Economics of Stabilisation

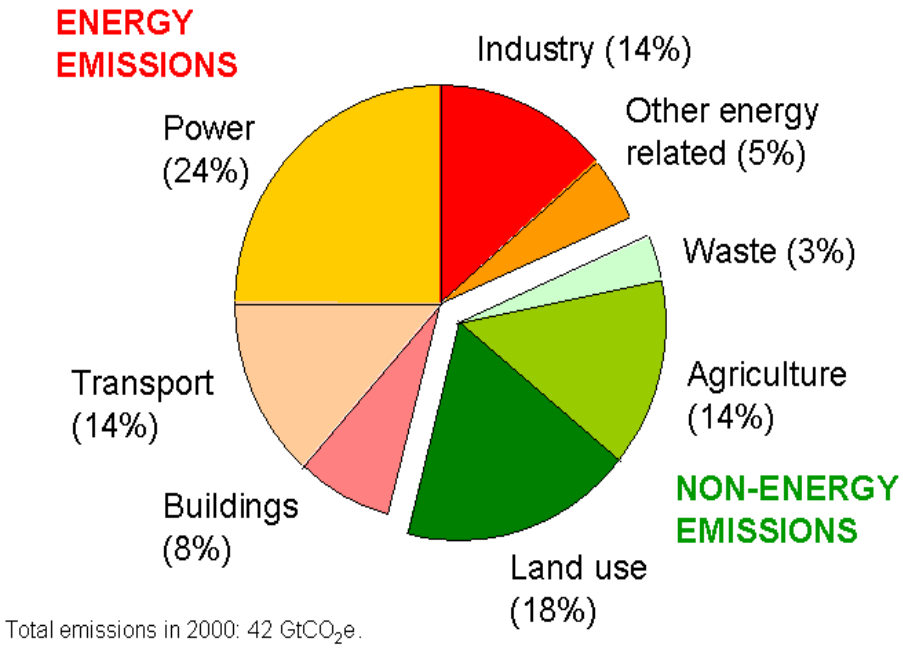


Stabilising below 450ppm CO_2e would require emissions to peak by 2010 with 6-10% p.a. decline thereafter.

If emissions peak in 2020, we can stabilise below 550ppm CO_2e if we achieve annual declines of 1 – 2.5% afterwards

MITIGATION COSTS

Strategies for Emission Reduction



Total emissions in 2000: 42 $GtCO_2e$.

Four ways to cut emissions:

- reducing demand
- improving efficiency
- lower-carbon technologies
- non-energy emissions

Estimating Costs of Mitigation

Expected cost of cutting emissions consistent with 550ppm CO2e stabilisation trajectory averages 1% of GDP per year.

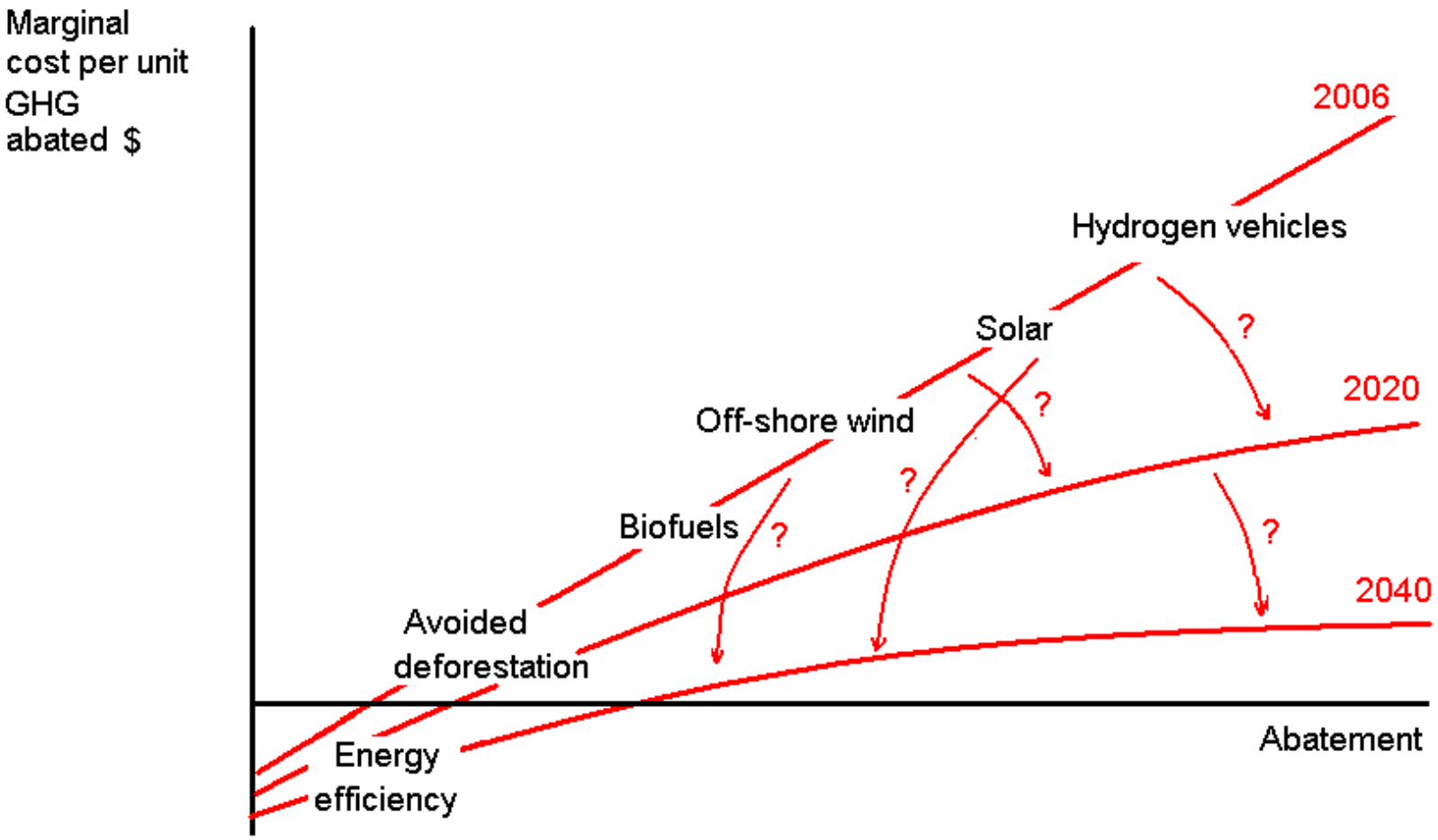
- Macroeconomic models: 1% of GDP in 2050, in range +/- 3%.
- Resource cost: 1% of GDP in 2050, in range –1% to +3.5%.

Costs will not be evenly distributed:

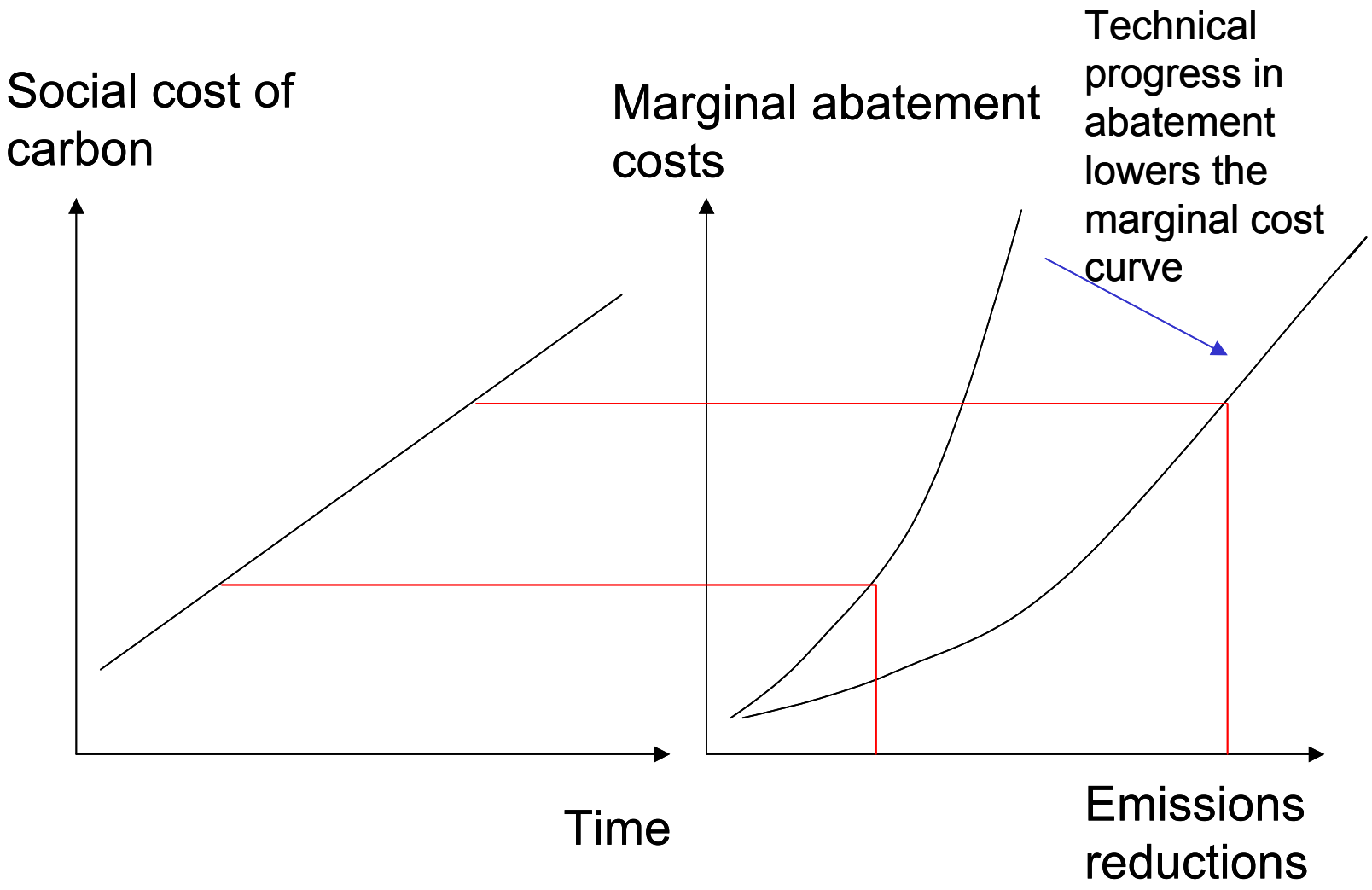
- Competitiveness impacts can be reduced by acting together.
- New markets will be created. Investment in low-carbon electricity sources could be worth over $500bn a year by 2050.

Strong mitigation is fully consistent with the aspirations for growth and development in poor and rich countries.

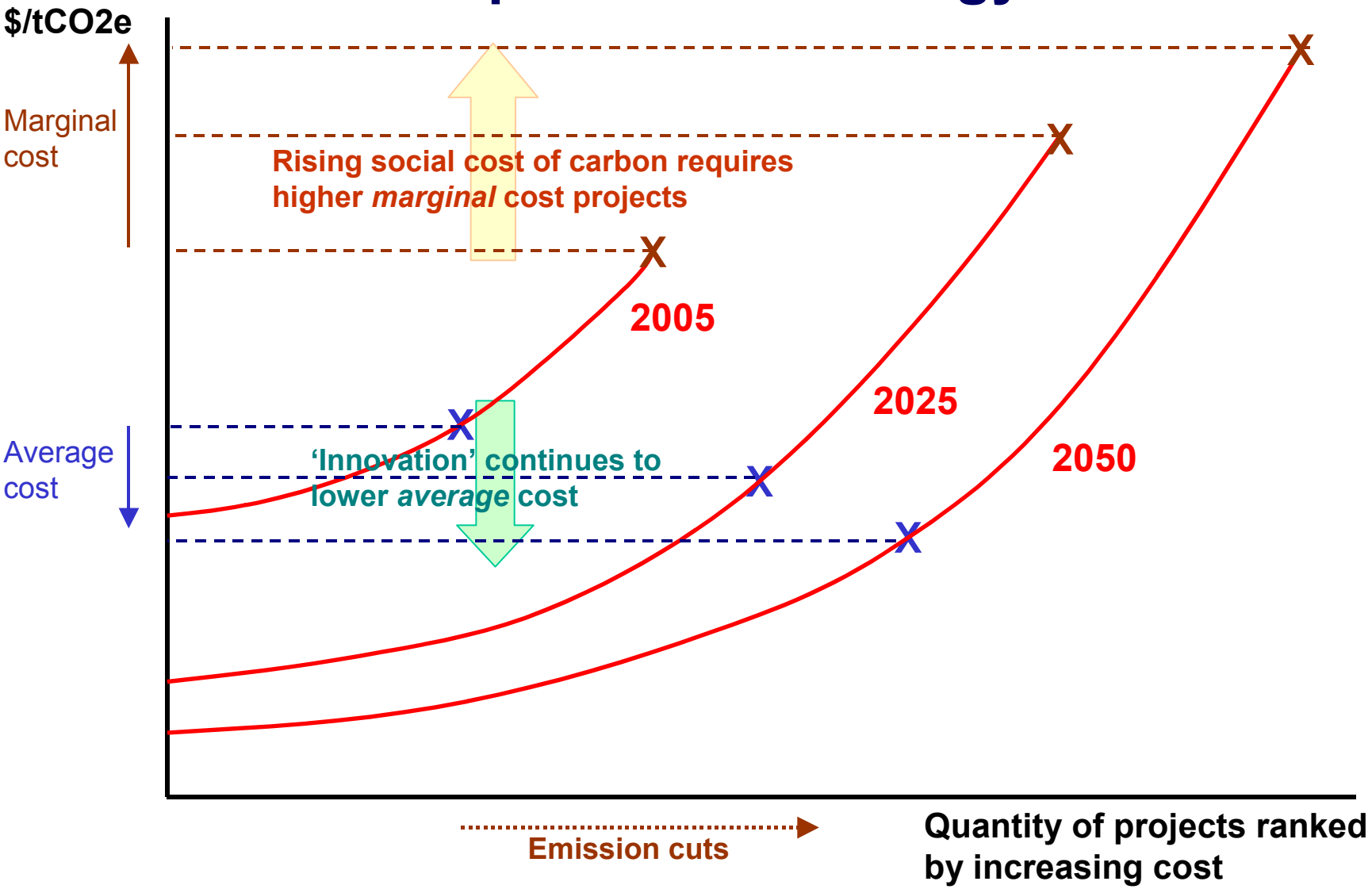
Illustrative Marginal Abatement Option Cost Curve



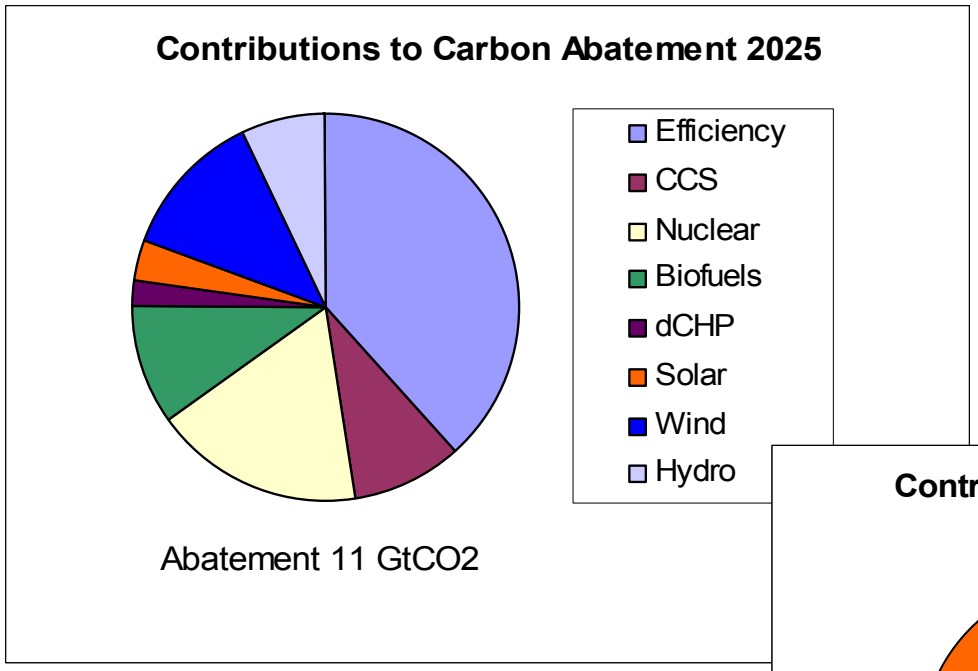
The Relationship Between the Social Cost of Carbon and Emissions Reductions

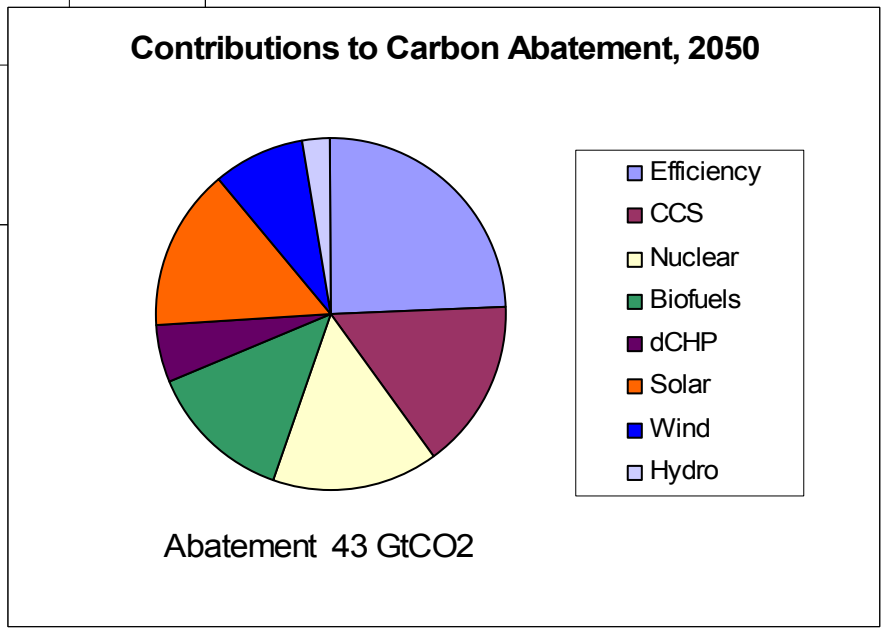


Illustrative Cost Per Unit of GHG Abated for a Specific Technology



Illustrative Distribution of Emission Savings by Technology





Average Cost of Reducing Fossil Fuel Emissions to 18 GtCO2 in 2050

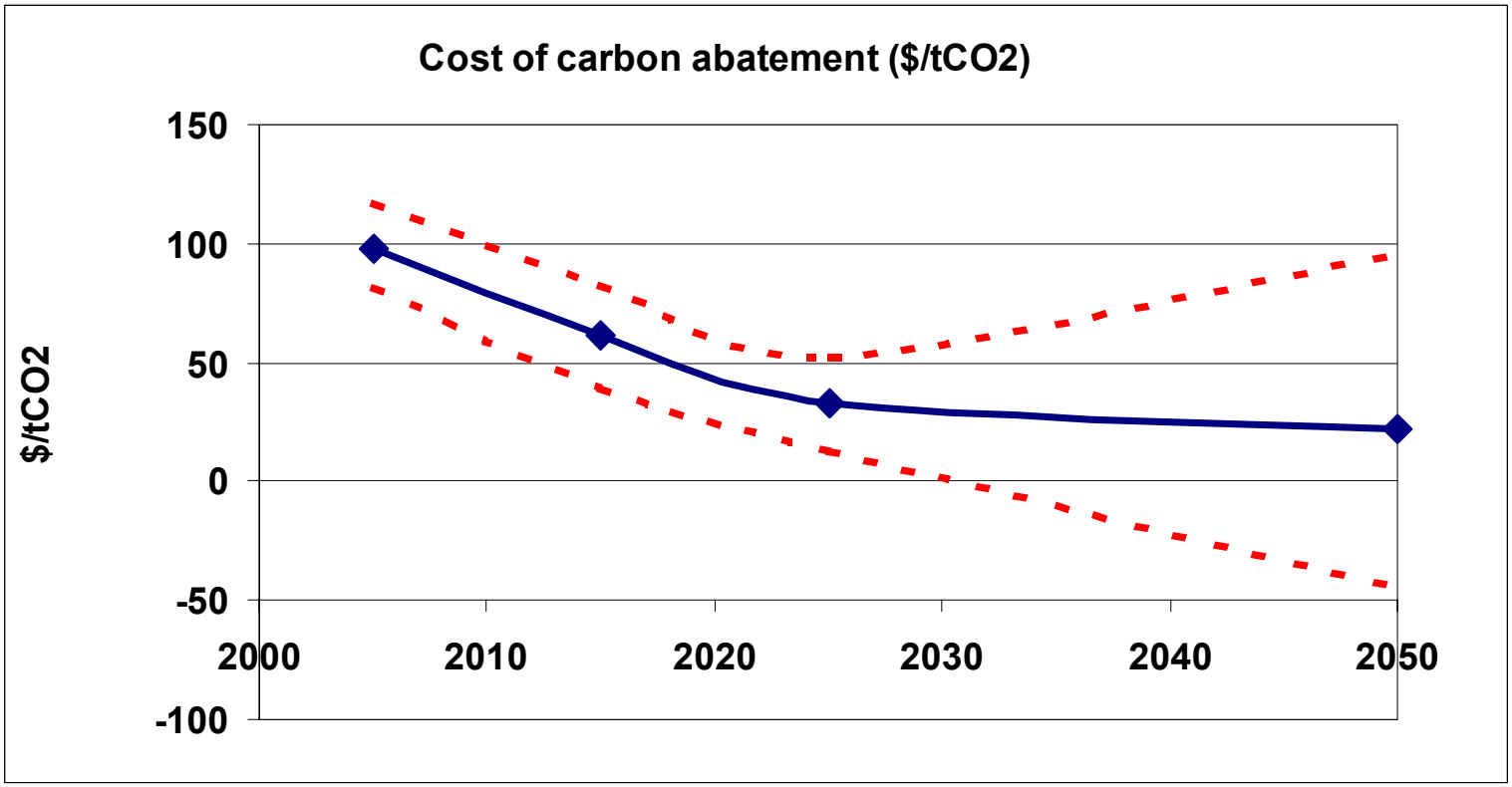
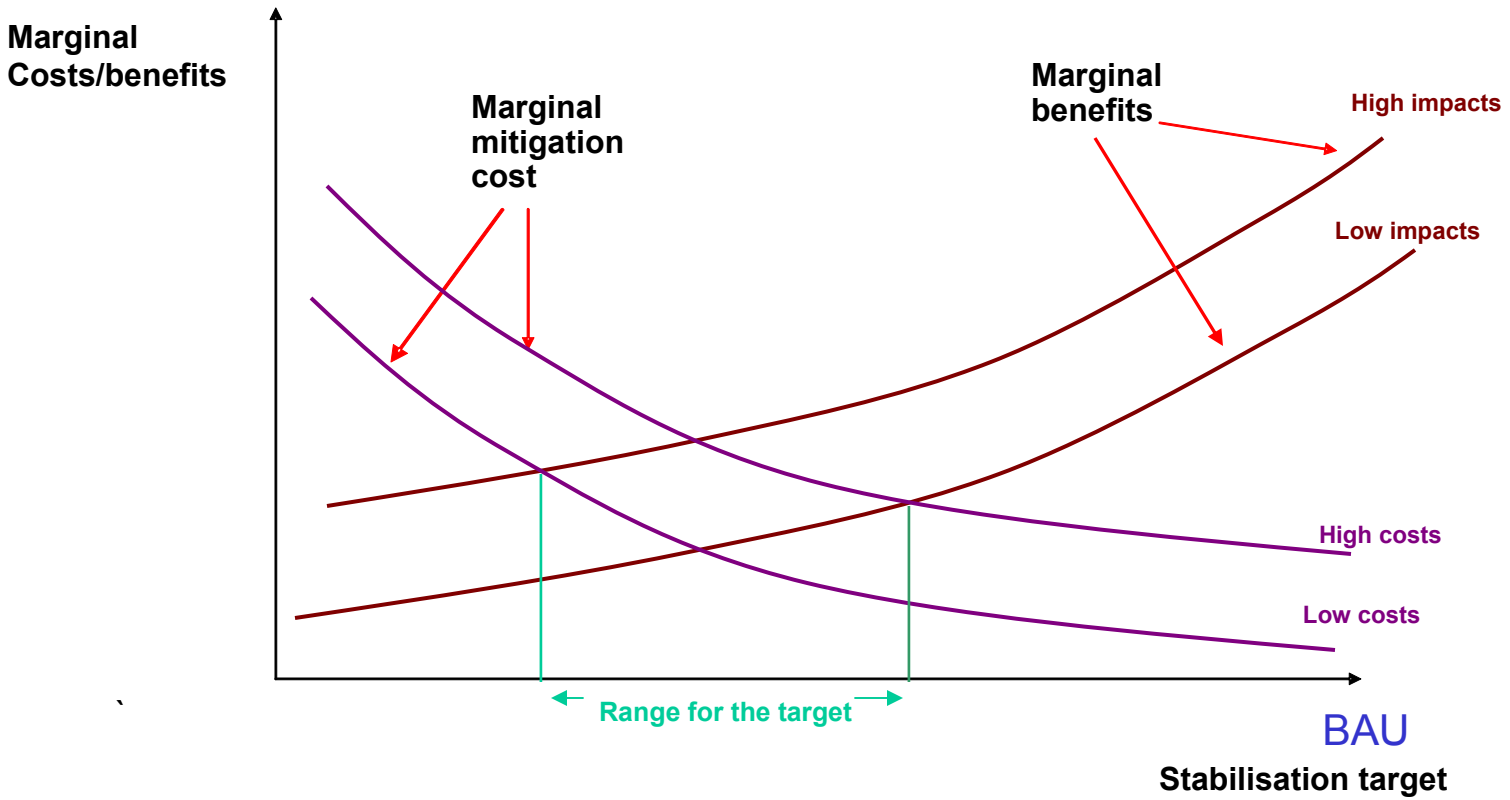


Table 9.1 Annual total costs of reducing fossil fuel emissions to 18 $GtCO_2$ in 2050			
	2015	2025	2050
Average cost of abatement, \$/t CO_2	61	33	22
Emissions Abated $GtCO_2$ (relative to emissions in BAU)	2.2	10.7	42.6
Total cost of abatement, \$ billion per year:	134	349	930

Schematic Representation of How to Select a Stabilisation Level



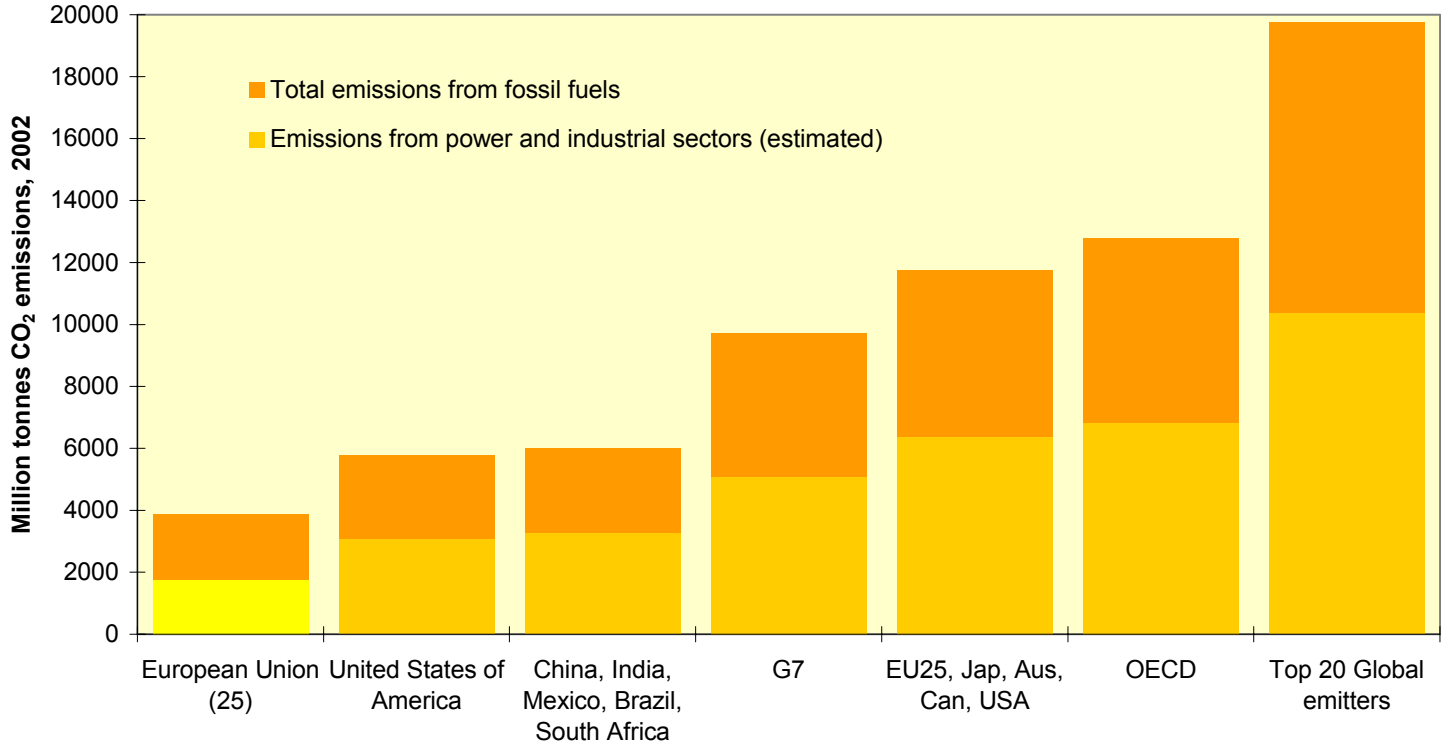
POLICY

Key principles of international action

Effective action requires:

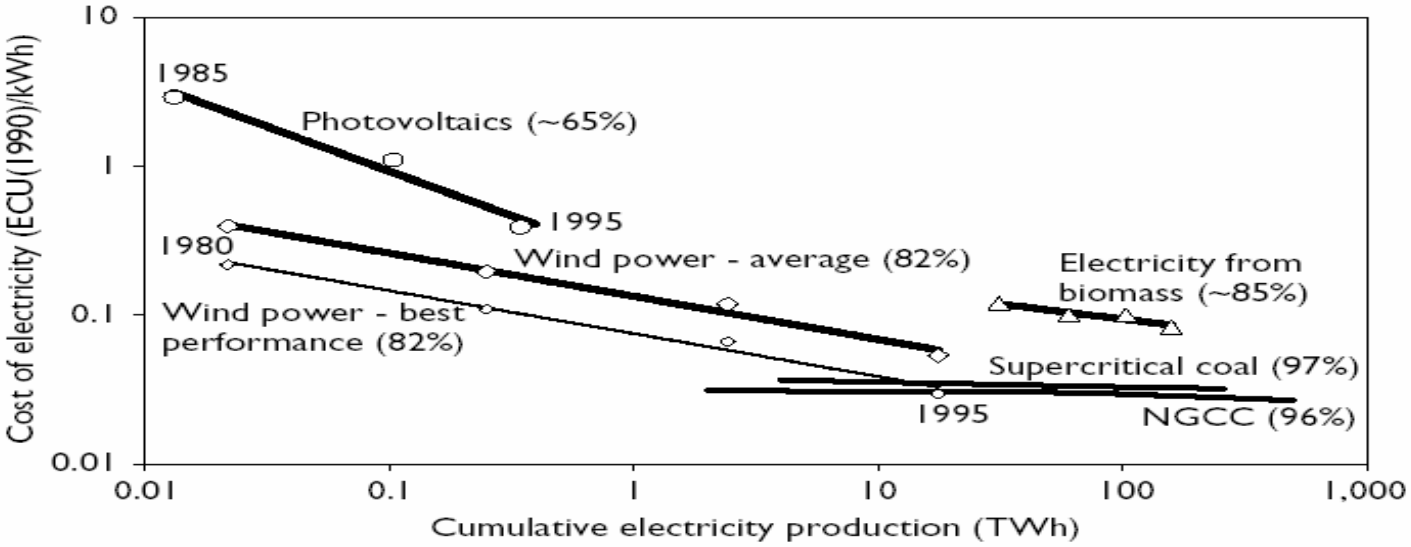
- Transparency and mutual understanding of actions and policies
- Long-term quantity goals to limit risk
- Short-term flexibility to limit costs
- A broadly comparable global price for carbon
- Cooperation to bring forward technology
- Moving beyond sticks and carrots
- Equitable distribution of effort
- Informing and mobilising public opinion

Global carbon markets can be expanded



- Increasing the size of global carbon markets – by expanding schemes to new sectors or countries, or linking regional schemes – can drive large flows across countries and promote action in developing countries

Technology needs more than a carbon price



Carbon price alone not enough to bring forward the technologies we need

One way of doing this is through global public funding for technologies:

- –R&D funding should double, to around $20 bn
- –Deployment incentives should increase 2 to 5 times, from current level of $34 bn

Adaptation

Adaptation is inevitable: climate change is with us and more is on the way

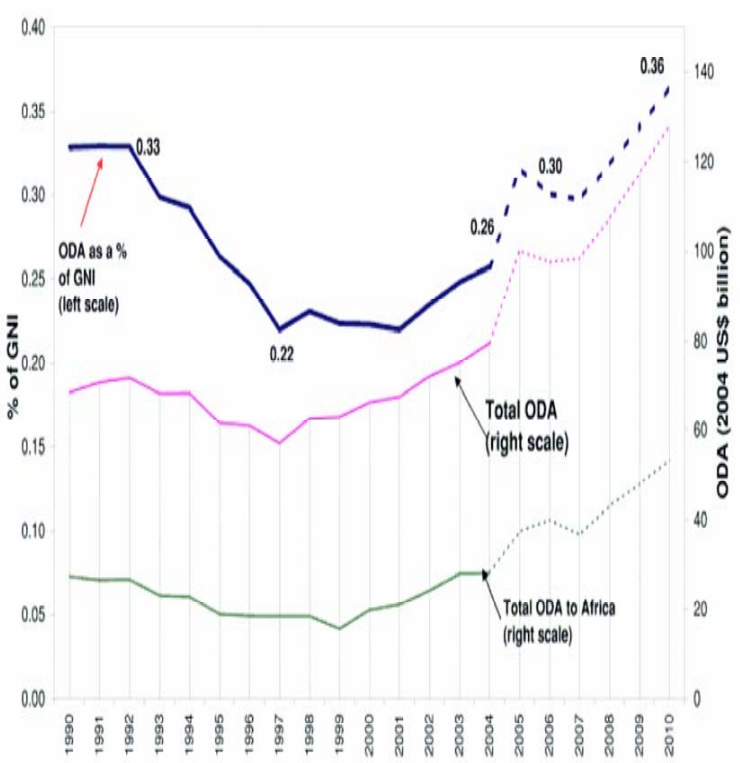
Adaptation cannot be a substitute for mitigation

- only reduce the costs of climate change...
- ...but these are rising rapidly
- for severe impacts there are limits to what adaptation can achieve
- Doesn't address risks and uncertainty

Adaptation crucial in developing countries

Adaptation

- Development increases resilience
- Adaptation will put strong pressure on developing country budgets and ODA: essential to meet 2010 and 2015 commitments
- International action also has a key role in supporting global public goods for adaptation
  - Disaster response
  - Crop varieties and technology
  - Forecasting climate and weather



Conclusion from Stern analysis

Unless emissions are curbed, climate change will bring high costs for human development, economies and the environment

- Concentrations of 550ppm CO_2e and above - very high risks of serious economic impacts
- Concentrations of 450ppm CO_2e and below - extremely difficult to achieve *now* and with current and foreseeable technology

Limiting concentrations within this range is possible. The costs are modest relative to the costs of inaction.

Decisive and strong international action is urgent: delay means greater risks and higher costs

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